

ENERGY AND PROTEIN CONTENT OF COYOTE PREY IN SOUTHEASTERN IDAHO

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ABSTRACT.—Gross energy, digestible energy, crude protein, and digestible crude protein were estimated for two leporids and five rodents that were the primary prey of coyotes (*Canis latrans*) in southeastern Idaho. Digestible protein estimates differed (38%–54%) more than digestible energy (3.5–4.4 kcal), in the prey examined.

Information on the energy and nutrient content of small mammals that are the food of coyotes (*Canis latrans*) is necessary to evaluate prey selection (Pyke et al. 1977). In addition, those data are valuable in ecological studies of other predators, and for research on nutrient cycling and energy flow through ecosystems (Golley 1960, Odum et al. 1962, Weigert 1965, Fleharty et al. 1973). Research has shown that energy composition of some small mammal bodies varies seasonally and geographically (Gorecki 1965, Fleharty et al. 1973, Cameron et al. 1979), which indicates that the use of data from the immediate study area may be necessary.

The purpose of this study was to estimate the gross and digestible energy and crude protein and digestible crude protein of small mammals in conjunction with a study of coyote feeding strategies (Johnson and Hanson 1979, MacCracken and Hansen 1982). Large differences in prey body composition might influence coyote food selection.

METHODS

Small mammals were collected from the Idaho National Engineering Laboratory (INEL) Site in southeastern Idaho ($\approx 113^{\circ}00'W$, $44^{\circ}00'N$). The INEL Site occupies about 231,500 ha of the Upper Snake River Plain. The dominant vegetation of the study area was a sagebrush/bunchgrass (*Artemisia/Agropyron*) shrubsteppe. Dr. B. L. Keller of Idaho State University supplied five specimens each of the deer mouse (*Peromyscus maniculatus*), Townsend's ground squirrel (*Spermophilus townsendii*), Ord's

kangaroo rat (*Dipodomys ordii*), and least chipmunk (*Eutamias minimus*). All specimens were trapped during the summer of 1982 and frozen. Additionally, five specimens each of the black-tailed jackrabbit (*Lepus californicus*), Nuttall cottontails (*Sylvilagus nuttallii*), and montane vole (*Microtus montanus*) were collected during July 1983 and frozen.

Frozen specimens were chopped into approximately 1 cm³ pieces, oven-dried at 60 C for 72 h, then ground in a Willey Mill to pass through a 2-mm mesh screen. Samples were then submitted to the Nutrient Analysis Lab, Colorado State University, to determine gross energy (kcal/g dry matter) by bomb calorimetry and crude protein (% dry matter) by Kjeldahl nitrogen ($\times 6.25$), in duplicate for each individual animal.

The digestible fraction of each species was estimated using the data of Johnson (1978). Litvaitis and Mautz (1980) reported similar results from feeding trials with captive coyotes. Using Johnson's estimates, digestible energy and protein were calculated for each species on a dry weight basis.

Analysis of variance, followed by Tukey's mean separation procedure, was used to test for differences in mean gross energy and crude protein among the species examined ($P = 0.05$). Adequacy of sample size ($N = 5$) for each species for gross energy and crude protein estimates was assessed using a standard formula based on the t distribution (Giles 1971:158). Adequate sample size (N_e) precision levels were set so as to permit estimates within 10% of the mean with 95% confidence.

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TABLE 1. Mean (SE) gross energy (kcal/g dry matter), digestible gross energy¹, crude protein (% dry matter), and digestible crude protein of coyote prey on the Idaho National Engineering Laboratory in southeastern Idaho. N_e is estimated adequate sample size² for gross energy and crude protein values.

Species	Energy			Protein		
	Gross	N_e	Digestible	Crude	N_e	Digestible
<i>Lepus californicus</i>	4.8(0.1)	2	3.8(0.2)	64.0(1.3)	2	50.6(1.3)
<i>Sylvilagus nuttallii</i>	5.0(0.2)	4	4.1(0.2)	65.4(2.5)	5	53.6(2.5)
<i>Microtus montanus</i>	5.0(0.2)	4	3.9(0.2)	65.4(2.5)	5	51.0(2.5)
<i>Peromyscus maniculatus</i>	5.1(0.1)	1	3.9(0.2)	62.5(1.9)	3	47.5(1.9)
<i>Spermophilus townsendii</i>	5.6(0.4)	19	4.4(0.4)	48.5(4.1)	26	38.3(4.1)
<i>Dipodomys ordii</i>	4.6(0.1)	2	3.5(0.1)	62.7(1.4)	2	47.7(1.4)
<i>Eutamias minimus</i>	4.9(0.1)	2	3.9(0.1)	60.4(1.9)	4	48.3(1.9)

¹Estimates of the digestible fraction (% dry matter) of each species were reported by Johnson (1978).

²Adequate sample size was determined using a standard formula based on the t distribution (Giles 1971: 158).

RESULTS AND DISCUSSION

Mean gross energy estimates ranged from 4.6 to 5.6 kcal/g and were greatest ($P < 0.03$) for the Townsend's ground squirrel (Table 1). The other small mammals examined were similar in energy content except Ord's Kangaroo rat, which was the lowest ($P < 0.03$).

Mean digestible gross energy ranged from 3.5 to 4.1 kcal/g being greatest ($P > 0.05$) for the Townsend's ground squirrel, and lowest ($P > 0.05$) for Ord's kangaroo rat (Table 1).

Mean crude protein estimates ranged from 48.5 to 65.4% (Table 1). Crude protein was lowest ($P < 0.04$) in Townsend's ground squirrel and greatest ($P > 0.05$) for the Nuttall cottontail and montane vole. Digestible protein ranged from 38.3% for Townsend's ground squirrel to 53.6% for Nuttall cottontail.

Five individuals of each species were adequate to estimate energy and protein content, except for Townsend's ground squirrel (Table 1). The large variation in energy and protein content for Townsend's ground squirrel appeared to be related to fat content because some individuals had considerable fat, whereas other did not. This was probably attributable to specimens originating from different cohorts and/or captured at different stages in the annual fat cycle.

Our gross energy estimates were similar to those of other published studies which examined the same species or genera. Gorecki (1965) reported a mean (\pm SD) summer estimate of 5.1 (\pm 0.5) kcal/g for *Microtus arvalis*, which is 0.1 kcal/g greater than our estimate for montane voles. Fleharty et al. (1973) examined energy content of four ro-

dents, including the deer mouse and prairie vole (*M. ochrogaster*). They reported seasonal extremes ranging from 5.05 to 5.14 kcal/g for the deer mouse and 4.91 to 5.01 kcal/g for the prairie vole. The maximum values of Fleharty et al. (1973) are similar to our data for the deer mouse and montane vole. Gorecki (1965) stated that energy values were greatest in summer in his study. Davison et al. (1978) examined energy content of the snowshoe hare (*Lepus americanus*), meadow vole (*M. pennsylvanicus*), and white-footed mouse (*P. leucopus*) collected from October through January. Their data are similar to ours for species of the same genus. Litvaitis and Mautz (1980) presented energy estimates for the snowshoe hare (4.97 kcal/g) and laboratory mouse (*Mus musculus*) (6.00 kcal/g), but collection dates were not given. Both of those estimates are higher than we observed for the black-tailed jackrabbits and deer mouse.

Few studies have examined crude protein levels of wild mammals (Davison et al. 1978, Litvaitis and Mautz 1980). Energy is typically the currency used in modeling foraging theory and in experiments testing those models (Pyke et al. 1977). However, Davies (1977) suggested that nutrients as well as energy may be important in prey selection, and Pulliam (1974) cited protein as having potential importance. Mean crude protein levels for the black-tailed jackrabbit estimated in our study were 6% to 8% lower than those reported for the snowshoe hare by Davison et al. (1978) and Litvaitis and Mautz (1980). Protein levels for the deer mouse reported here were 3% to 9% greater than those reported for the white-footed mouse (Davison et al. 1978) and laboratory mouse (Litvaitis and Mautz 1980).

Our results and those of Davison et al. (1978) and Litvaitis and Mautz (1980) indicate that percent crude protein varies among species more than does gross energy. This observation suggests that generalizations about protein content of animal bodies across species lines are of limited value. However, our conclusions and those of other studies cited herein suggest that gross energy levels are similar among species and locales.

To what degree coyotes are able to detect differences in prey body composition is unknown. Digestible energy ranged from 3.5 to 4.4 kcal/g dry matter, or a 25% difference. Apparently, prey abundance, body size, and/or defensive strategies may be more important in coyote prey selection. However, digestible protein estimates ranged from 38% to 54%, or a 42% difference. Protein could be important in prey selection. Furthermore, other nutrients and trace elements should be studied.

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